

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Microlepidia strigosa var. *mauiensis*

Common Name:

Maui fern

Lead region:

Region 1 (Pacific Region)

Information current as of:

06/01/2013

Status/Action

☐ Funding provided for a proposed rule. Assessment not updated.

☐ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

☐ New Candidate

☒ Continuing Candidate

☐ Candidate Removal

☐ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

☐ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

☐ Range is no longer a U.S. territory

☐ Insufficient information exists on biological vulnerability and threats to support listing

☐ Taxon mistakenly included in past notice of review

☐ Taxon does not meet the definition of "species"

☐ Taxon believed to be extinct

☐ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

X Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing?
Yes

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (<http://endangered.fws.gov/>) provides information on listing actions taken during the last 12 months. The past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, emergency listings, and essential litigation-related, administrative, and program management functions.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories:** Hawaii
- **US Counties:** Hawaii, HI, Maui, HI
- **Countries:** United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories:** Hawaii
- **US Counties:** Hawaii, HI, Honolulu, HI, Maui, HI
- **Countries:** United States

Land Ownership:

Microlepia strigosa var. *mauiensis* occurs on State land in the Hilo Watershed and upper Waiakea Forest Reserves (FR) on Hawaii; on private (including Waikamoi Preserve), State (West Maui Natural Area Reserve), and Federal land (Haleakala National Park) on Maui; and on County and private land on Oahu.

Lead Region Contact:

ARD-ECOL SVCS, Jesse D'Elia, 5032312349, jesse_delia@fws.gov

Lead Field Office Contact:

Biological Information

Species Description:

Microlepia strigosa var. *mauiensis* plants are terrestrial, medium-sized, with fronds less than 40 inches (in) (100 centimeters (cm)) long. This taxon is an extremely hairy variety of *M. strigosa*, with the stipes, rachises, costae, and entire fronds covered with uniform, jointed hairs with pointed tips. The rachises are often zigzag (Palmer 2003, p. 186).

Taxonomy:

This taxon was originally described as *Microlepia mauiensis* by Wagner (1993), from a collection made at Hanaula, west Maui. In the most recent treatment of all Hawaiian ferns, Palmer (2003, p. 186) recognizes this entity as an endemic variety of the indigenous *Microlepia strigosa*. Lau expressed some doubt that this entity represents a continuum of *Microlepia strigosa*, as it may be a distinct species (*Microlepia mauiensis*) (Lau 2007, pers. comm.). According to Lau, further taxonomic study is needed, as well as additional surveys statewide in suitable habitat (Lau 2007, pers. comm.).

Habitat/Life History:

Typical habitat is mesic to wet forest at elevations between 1,394 and 6,004 feet (ft) (425 and 1,830 meters (m)) (Palmer 2003, p. 186; Hawaii Biodiversity and Mapping Program (HBMP) 2008).

Historical Range/Distribution:

Little is known of the historical locations of *Microlepia strigosa* var. *mauiensis*. The type was collected at Hanaula in the west Maui Mountains (Wagner 1993).

Current Range Distribution:

Currently, *Microlepia strigosa* var. *mauiensis* is found in the Waiakea and Hilo Watershed FRs, on the island of Hawaii; at Pohakea and Poelua gulches on west Maui, and at Hanaula, in The Nature Conservancy's Waikamoi Preserve, and at Manawainui in Haleakala National Park on east Maui; and at Makaleha and Makaha Valley in the Waianae Mountains on Oahu (Lau 2007, pers. comm.; Oppenheimer, in litt. 2007; HBMP 2008; Oppenheimer, in litt. 2008; Welton, in litt. 2008).

Population Estimates/Status:

Microlepia strigosa var. *mauiensis* is known from nine populations totaling at least 50 to more than 100 individuals on Maui, Hawaii, and Oahu (Palmer 2003, p. 186; Lau 2007, pers. comm.; Oppenheimer, in litt. 2007 and 2008; Welton, in litt. 2008). The island of Hawaii populations are at Saddle Road (15 individuals) and Puu Oo trail (20 individuals) (HBMP 2008). Populations on west Maui occur at Poelua (numbers unknown), and Pohakea and Hanaula Gulches (at both sites, more than 100 total observed in 1984), and on east Maui in the Waikamoi Preserve (not uncommon) and at Manawainui (fewer than 20 individuals) (Lau 2007, pers. comm.; Oppenheimer, in litt. 2007 and 2008; Welton, in litt. 2008; Bily, in litt. 2009; Welton, in

litt. 2010). Hybrid and non-hybrid populations on Oahu occur at Makaleha (a patch of individuals) and Makaha Valley (1 individual), with 15-20 individuals of which many are hybrids at west Makaleha (Lau 2007, pers. comm.; Kawelo, in litt. 2010; Ching, in litt. 2011; Perlman, in litt. 2011). Botanists suggest this variety may be more widespread and could be found in more areas if surveys were conducted (Lau 2007, pers. comm.; Kawelo, in litt. 2010; Hadway, in litt. 2013). According to the Plant Extinction Prevention Program (PEPP) (in litt. 2012), non-hybrid individuals of this species are now only represented in the wild on Oahu by 15 to 20 plants located at the Makaleha population site.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Microlepidia strigosa var. *mauiensis* is highly threatened by feral pigs (*Sus scrofa*) that degrade and destroy habitat (Oppenheimer, in litt. 2007; HBMP 2008; Bily, in litt. 2009).

Pigs of Asian ancestry were introduced to Hawaii by the Polynesians, and the Eurasian type was introduced to Hawaii by Captain James Cook in 1778, with many other introductions thereafter (Tomich 1986, p. 121). Some pigs raised as food escaped into the forests of Hawaii, Kauai, Oahu, Molokai, Maui, and Niihau, formed herds, and are now managed as a game animal by the State to optimize hunting opportunities (Tomich 1986, p. 125; State of Hawaii 2001). A study was conducted in the 1980s on feral pig populations in the Kipahulu Valley on Maui (Diong 1982, 408 pp.). This valley consists of a diverse composition of native ecosystems, from near sea level to alpine, and forest types ranging from mesic to wet, *Acacia koa* (koa) to *Metrosideros polymorpha* (ohia), similar to the habitat of *Microlepidia strigosa* var. *mauiensis*. Rooting by feral pigs was observed to be related to the search for earthworms, with rooting depths averaging 8 in (20 cm) greatly disrupting the leaf litter and topsoil layers and contributing to erosion and changes in ground topography. The feeding habits of pigs created seed beds, enabling the establishment and spread of weedy species such as *Psidium cattleianum* (strawberry guava). The study concluded that all aspects of the food habits of pigs are damaging to the structure and function of the Hawaiian forest ecosystem (Diong 1982, pp. 164-165). The effects on mesic and wet forest habitat by foraging of feral pigs have also been reported in fencing studies. In a fencing study conducted in the montane bogs of Haleakala, it was found that when feral pigs were fenced out of an area the cover of native plant species increased from 6 percent to 95 percent within six years of protection (Loope et al. 1991, p. 3).

Hawaiian ecosystems, having evolved without hoofed mammals, are susceptible to large-scale disturbance by feral pigs and other introduced ungulates (Loope et al. 1991, p. 3). Because of demonstrated habitat modifications by feral pigs such as destruction of native plants, disruption of topsoil leading to erosion, and establishment and spread of nonnative plants; the U.S. Fish and Wildlife Service (FWS) believes they are a threat to *M. strigosa* var. *mauiensis*.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

None known.

C. Disease or predation:

Predation by feral pigs is a likely threat to *Microlepidia strigosa* var. *mauiensis* (HBMP 2008; Oppenheimer, in litt. 2007; Bily, in litt. 2009). In a study conducted in the 1980s, feral pigs were observed browsing on young shoots, leaves and fronds of a wide variety plants, of which over 85 percent were endemic species (Diong 1982, p. 138). A stomach content analysis in this study showed that the pigs food sources consisted of native plants, 60 percent of which were *Cibotium* spp. (tree ferns), alternating with *Psidium cattleianum* (strawberry guava) when it was available. Pigs were observed felling and removing the bark of *Clermontia*, *Cibotium*,

Coprosma, *Psychotria*, and *Hedyotis* species (herbaceous and woody plants), and causing enough damage to kill larger trees over a few months of repeated feeding (Diong 1982, pp. 138, 144).

Because Hawaii's native plants evolved without any browsing or grazing mammals present, many lost natural defenses to such impacts (Carlquist 1980, pp. 28-29). Browsing by ungulates has been observed on many other native species, including common and rare or endangered species (Cuddihy and Stone 1990, pp. 63-64; Loope et al. 1991, p. 3). Therefore, even though we have no evidence of browsing for this species, it is likely that pigs impact *M. strigosa* var. *mauiensis* directly as well as the surrounding habitat.

D. The inadequacy of existing regulatory mechanisms:

Microlepidia strigosa var. *mauiensis* currently receives no protection under Hawaii's endangered species law (HRS, Sect. 195-D) or the Federal Endangered Species Act (16 U.S.C. §1531-1544).

Pigs are managed in Hawaii as game animals, but many populate inaccessible areas where hunting is difficult, if not impossible, and therefore has little effect on their numbers (Hawaii Heritage Program 1990, p. 3). Hunting is allowed on all islands either year-round or during certain months, depending on the area (Hawaii Department of Land and Natural Resources 1999, 2003); however, public hunting is not adequate to eliminate this threat to *M. strigosa* var. *mauiensis*.

E. Other natural or manmade factors affecting its continued existence:

This variety is threatened by alien plant species that degrade habitat and outcompete native plants (Oppenheimer, in litt. 2007). On west Maui, the nonnative plant species reported to be the greatest threats to *Microlepidia strigosa* var. *mauiensis* are *Tibouchina herbacea* (glorybush) and *Clidemia hirta* (Kosters curse) (Oppenheimer, in litt. 2007); and on east Maui, *Hedychium gardnerianum* (kahili ginger) poses a threat to those individuals at Waikamoi (Bily, in litt. 2009). The specific nonnative plant threats on Oahu and Hawaii Island are not described.

Clidemia hirta is a noxious shrub first cultivated on Oahu before 1941. This pest plant forms a dense understory, shading out native plants and hindering their regeneration, and is considered a major alien plant threat (Wagner et al. 1985, p. 41; Smith 1989, p. 189). The most promising biological control to date for *C. hirta* is the *Colleotrichum* fungus, *Gloesporioides* f. sp. *clidemiae*, released in 1986. Although there is no quantitative data available, it has an observable negative impact. Other agents tested were a moth (*Antiblemma acclinalis*), a leaf feeding beetle (*Lius poseidon*), a fruit and flower-feeding insect (*Mompha trithalama*), and a terminal growth feeding insect (*Liothrips urichi*), all with lesser control success than the fungus (Smith 1989, p. 189).

Hedychium gardnerianum is native to India (Nagata 1999, p. 1,623). This showy ginger was introduced for ornamental purposes, and was first collected in 1954 at Hawaii Volcanoes National Park (Wester 1992, p. 124). *H. gardnerianum* grows over 3.3 ft (1 m) tall in open light environments, preferring a warm moist climate; however it will readily grow in full shade beneath a forest canopy (Global Invasive Species Database (GISD) 2005). It forms vast, dense colonies, displacing other plant species, and reproduces by rhizomes. The conspicuous, fleshy, red seeds are dispersed by fruit-eating birds as well as man. Aircraft-based analysis has found that ginger reduces the amount of nitrogen in the *Metrosideros* forest canopy in Hawaii, a finding subsequently corroborated by ground based sampling (Asner and Vitousek 2005). It may also block stream edges, altering water flow (GISD 2005). *H. gardnerianum* can be controlled by herbicides, but biological control is considered the only practical approach for the long-term management of large infestations in native forests. The ability of the bacterium *Ralstonia* (= *Pseudomonas*) *solanacearum* to cause bacterial wilt in *H. gardnerianum* in the field, together with its lack of virulence in other ginger species, contributes to its potential as a biological control agent (Anderson and Gardner 1999, p. 95; Anderson 2003).

Tibouchina herbacea, a member of the Melastomataceae family, is native to southern Brazil, Uruguay, and

Paraguay (Wagner et al. 1999a, p. 915). In Hawaii, it is naturalized and abundant in disturbed mesic to wet forest on the islands of Hawaii, Lanai and is rapidly expanding its range over West Maui. It has become widely established in the lower half of Kapunakea Preserve over the last decade. People, pigs, and wind seem to be the primary vectors of this habitat-modifying weed. It forms dense thickets, crowding out all other plant species and inhibiting regeneration of native plants (The Nature Conservancy 2008, p. 12). All members of this genus are declared noxious in the state of Hawaii (HAR Title 4, Subtitle 6, Chapter 68). Research is ongoing for biological controls of *T. herbacea* (Smith 1998; The Nature Conservancy 2008, p. 12).

The original native flora of Hawaii consisted of about 1,400 species, nearly 90 percent of which were endemic. Of the current total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent were introduced from other parts of the world, and nearly 100 species have become pests (Smith 1985, p. 180; Wagner et al. 1999a, p. 45). Several studies (Cuddihy and Stone 1990, p. 74; Robichaux et al. 1998, p. 4) indicate nonnative plant species may outcompete native plants similar to *Microlepia strigosa* var. *mauiensis*. Competition may be for space, light, water, or nutrients, or there may be a chemical produced that inhibits growth of other plants (Smith 1985, pp. 227-230; Cuddihy and Stone 1990, p. 74). In addition, nonnative pest plants found in habitat similar to that of this species have been shown to make the habitat less suitable for native species (Smith 1985, pp. 240-241; Loope and Medeiros 1992, pp. 7-8; Medeiros et al. 1992, p. 30; Ellshoff et al. 1995, pp. ii, 3-4; Meyer and Florence 1996, p. 778; Medeiros et al. 1997, pp. 23-24, Loope et al. 2004, p. 1,472). In particular, alien pest plant species degrade habitat by modifying availability of light, altering soil-water regimes, modifying nutrient cycling, or altering fire characteristics of native plant communities (Smith 1985, pp. 227-230; Cuddihy and Stone 1990, p. 74; Vitousek et al. 1997, pp. 6-10). Because of demonstrated habitat modification and resource competition by nonnative plant species in habitat similar to mesic to wet forest habitat of *M. strigosa* var. *mauiensis*, the FWS believes nonnative plant species are a threat to *M. strigosa* var. *mauiensis*.

In some cases, hybridization makes it difficult to clearly understand the status of the species in certain locations (Kawelo, in litt. 2009).

Conservation Measures Planned or Implemented :

The West Maui Mountain Watershed Partnership, a non-governmental, non-profit partnership composed of west Maui landowners and managers, received funding over five years (2000 to 2005) from the FWS for ungulate exclosure fences, which have been completed, and for ungulate and nonnative plant control, which is ongoing (USFWS 2005; Hawaii Division of Forestry and Wildlife 2006). These actions may provide protection for the individuals of *Microlepia strigosa* var. *mauiensis* in the West Maui Mountains.

The Nature Conservancy of Hawaii manages the Waikamoi Preserve on east Maui. This Preserve is largely funded through the States Natural Area Reserve Partnership (NAP) program. A long-range management plan for this Preserve has been developed and implemented (The Nature Conservancy of Hawaii 1999). On Oahu, Ching (in litt. 2011) reported *M. strigosa* var. *mauiensis* individuals in an area fenced for *Cyanea grimeseana* ssp. *obatae* in western Makaleha Valley. Conservation measures such as fence construction, monitoring, nonnative plant removal, and pig control as described in the plan may provide protection to individuals of *M. strigosa* var. *mauiensis* that occur within the Preserve.

According to State of Hawaii botanists, this species is represented in ex situ collections at Lyon Arboretum (five individuals from Makalena, Oahu) (in litt. Imoto 2013).

Summary of Threats :

Based on our evaluation of habitat degradation and loss by feral pigs and nonnative plants, we conclude there is sufficient information to develop a proposed rule for this species (once the taxonomic questions have been resolved¹) due to the present and threatened destruction, alteration, or curtailment of its habitat and range, and the displacement of individuals of *Microlepia strigosa* var. *mauiensis*, due to competition with nonnative

plants for space, nutrients, water, and light. Predation by feral pigs is a likely threat to *M. strigosa* var. *mauiensis*. We find that this species is warranted for listing throughout all of its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

¹ The taxonomic validity of this species must be resolved before developing a proposed listing rule (USFWS 2011; Conry, in litt. 2012).

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

- Conduct taxonomic review to determine if *Microlepidia strigosa* var. *mauiensis* is a variety or a distinct species.
- Survey for populations of *M. strigosa* var. *mauiensis* in areas of potentially suitable habitat.
- Control feral pigs by removing these species from areas where populations of this species exist and preventing reinvasion through the use of exclosures.
- Determine specific nonnative plant threats to populations in east Maui, Oahu, and Hawaii Island.
- Control alien plants through physical, mechanical, and biological control methods, as well as herbicides when necessary. Continue to conduct research into potential biocontrol species.
- Begin propagation efforts for maintenance of genetic stock.
- Reintroduce individuals into suitable habitat within historic range that is being managed for known threats to this species.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

This variety is highly threatened by feral pigs that degrade and destroy habitat, and nonnative plants that compete for light and nutrients. Threats to the mesic to wet forest habitat of *Microlepia strigosa* var. *mauiensis* occur throughout its range and are expected to continue or increase without control or eradication.

Imminence :

Threats to *Microlepia strigosa* var. *mauiensis* from feral pigs and nonnative plants are considered imminent because they are ongoing.

☐ Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

☐ No Is Emergency Listing Warranted?

This variety does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. In addition, individuals of *Microlepia strigosa* var. *mauiensis* may benefit from conservation actions initiated by The Nature Conservancy of Hawaii, the Hawaii Division of Forestry and Wildlife Natural Area Reserves System, and the West and East Maui Mountain Watershed Partnerships. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *M. strigosa* var. *mauiensis* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

Description of Monitoring:

Much of the information on this form is based on the results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December of 1995. We incorporated additional information on this species from our files and the recently published manual on Hawaii's ferns, *Hawaii's Ferns and Fern Allies* (Palmer 2003). In 2004, the Pacific Islands Office contacted the following species experts: Robert Hobdy, retired from the Hawaii Division of Forestry and Wildlife; Joel Lau, Hawaii Natural Heritage Program; Arthur Medeiros, U.S. Geological Survey-Biological Resources Discipline; Hank Oppenheimer, resource manager for the Maui Land and Pineapple Company; and Steve Perlman and Ken Wood, National Tropical Botanical Garden. No new status or range information was provided. In 2005 we contacted species experts, but received no new information on this taxon. In 2006 new status and range information was provided by Joel Lau, HBMP, and Hank Oppenheimer, PEPP, and was incorporated into this assessment. In 2008 new information on status and range for this species was provided by Hank Oppenheimer, and by Patti Welton, National Park Service. In 2009 new information was provided by Pat Bily, The Nature Conservancy, and Kapua Kawelo, U.S. Army Environmental Division. In 2010 we received new information from Kapua Kawelo. In 2011, we contacted the species experts listed below and received new information from Susan Ching, PEPP-Oahu, and Steve Perlman, National Tropical Botanical Garden.

List all experts contacted in 2011:

Name Date Affiliation

Agorastos, Nick 02/16/11 Division of Forestry and Wildlife, Hawaii
Bakutis, Ane 02/16/11 Plant Extinction Prevention Program, Molokai
Ball, Donna 02/16/11 U.S. FWS, Partners Program, Hawaii
Bily, Pat 02/16/11 The Nature Conservancy, Maui
Bio, Kealii 02/16/11 Plant Extinction Prevention Program, Hawaii

Caraway, Vickie 02/22/11 Hawaii Division of Forestry and Wildlife, Oahu
Ching, Susan 02/16/11 Plant Extinction Prevention Program, Oahu
Clark, Michelle 02/16/11 U.S. FWS, Partners Program, Kauai
Duvall, Fern 02/16/11 Hawaii Division of Forestry and Wildlife, Maui
Fay, Kerri 02/16/11 The Nature Conservancy, Maui
Garnett, Bill 02/16/11 National Park Service, Kalaupapa, Molokai
Haus, Bill 02/16/11 National Park Service, Haleakala NP, Maui
Higashino, Jennifer 02/16/11 U.S. FWS, Partners Program, Maui
Imada, Clyde 02/16/11 Bishop Museum, Botany Department
Kawelo, Kapua 02/16/11 U.S. Army, Environmental Division
McDowell, Wendy 02/16/11 Plant Extinction Prevention Program, Kauai
Medeiros, Arthur 02/16/11 U.S. Geological Survey
Moses, Wailana 02/16/11 The Nature Conservancy, Molokai
Oppenheimer, Hank 02/16/11 Plant Extinction Prevention Program, Maui Nui
Perlman, Steve 02/16/11 National Tropical Botanical Garden
Perry, Lyman 02/16/11 Division of Forestry and Wildlife, Hawaii
Pratt, Linda 02/16/11 U.S.G.S., Biological Resources Division
Starr, Forest 02/16/11 U.S. Geological Survey
Stevens, Bryon 02/16/11 DLNR Natural Area Reserves, Maui
Ward, Joe 02/22/11 Puu Kukui Watershed Preserve
Welton, Patti 02/16/11 National Park Service, Haleakala NP, Maui
Wysong, Michael 02/16/11 DLNR Natural Area Reserves, Kauai

The Hawaii Biodiversity and Mapping Program identified this subspecies as imperiled (HBMP 2006). Based on the International Union for Conservation of Nature and Natural Resources Red List of Threatened Species, this species is recognized as Rare (could be considered at risk) by Wagner et al. (1999b, p. 56). *Microlepidia strigosa* var. *mauiensis* is included in the list of species in Hawaii's 2005 Comprehensive Wildlife Conservation Strategy (Mitchell et al. 2005, p. 671).

In 2013, we received new information from State Botanists and from the PEPP on this species.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Hawaii

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

On February 20, 2013, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. We received information from the State on March 23 and April 12, 2013, and incorporated it into this report.

Literature Cited:

Anderson, R.C. 2003. Kahili-make: a biological control project against kahili ginger. Presentation for U.S. Geological Survey, Biological Resources Division, Pacific Island Ecosystems Research Center, Honolulu.

Anderson, R.C., and D.E. Gardner. 1999. An evaluation of the wilt-causing bacterium *Ralstonia*

solanacearum as a potential biological control agent for the alien kahili ginger (*Hedychium gardnerianum*) in Hawaiian forests. Biological Control 15:89-96.

Asner, G., and P. Vitousek. 2005. Finding hidden invasives in a Hawaiian rain forest. Carnegie Institution, Department of Global Ecology News Release, March 7, 2005. 2 pp.
<http://www.globalecology.stanford.edu/DGE/CIWDGE/home/main%20page/press%20releases/asner%20hawaii>

Carlquist, S. 1980. Hawaii: A natural history, second edition. Pacific Tropical Botanical Garden, Honolulu. 468 pp.

Cuddihy, L.W., and C.P. Stone. 1990. Alteration of native Hawaiian vegetation; effects of humans, their activities and introductions. Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. 138 pp.

Diong, C.H. 1982. Population biology and management of the feral pig (*Sus scrofa* L.) in Kipahulu Valley, Maui.

Dissertation to the Zoology graduate division of the University of Hawaii. 408 pp.

Ellshoff, Z.E., D.E. Gardner, C. Wikler, and C.W. Smith. 1995. Annotated bibliography of the genus *Psidium*, with emphasis on *P. cattleianum* (strawberry guava) and *P. guajava* (common guava), forest weeds in Hawaii. Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. Technical Report 95. 105 pp.

(GISD) Global Invasive Species Database. 2005. *Hedychium gardnerianum* (herb)
<http://www.issg.org/database/species/ecology.asp?si=57&fr=1&sts>

Hawaii Department of Land and Natural Resources. 1999. Rules regulating game mammal hunting, updated 2003. 56 pp.

Hawaii Heritage Program. 1990 Management recommendations for Na Pali Coast State Park, island of Kauai. The Nature Conservancy, prepared for the Hawaii Department of Land and Natural Resources, Division of State Parks, Honolulu. 18 pp.

Hawaii Division of Forestry and Wildlife. 2006. Natural area reserves system.
<http://www.dofaw.net/nars/about.php>, accessed on April 10, 2007.

(HBMP) Hawaii Biodiversity and Mapping Program. 2008. Program database. Unpublished.

(HBMP) Hawaii Biodiversity and Mapping Program. 2006. *Microlepidia strigosa* var. *mauiensis*.
<http://hbmp.hawaii.edu/printpage.asp?spp=PPDEN06030>, accessed March 29, 2007.

Loope, L.L., A.C. Medeiros, and B.H. Gagn  . 1991. Recovery of vegetation of a montane bog following protection from feral pig rooting. Cooperative National. Park Resources Studies Unit, University of Hawaii, Honolulu, Technical Report 77. 23 pp.

Loope, L.L., and A.C. Medeiros. 1992. A new and invasive grass on Maui. Newsletter of the Hawaiian Botanical Society 31:7-8.

Loope, L., F. Starr, and K. Starr. 2004. Protecting endangered Hawaiian plant species from displacement by invasive plants on Maui, Hawaii. Weed Technology 18:1472-1474.

Medeiros, A.C., L.L. Loope, T. Flynn, S.J. Anderson, L.W. Cuddihy, and K.A. Wilson. 1992. Notes on the

status of an invasive Australian tree fern (*Cyathea cooperi*) in Hawaiian rain forests. *American Fern Journal* 82:27-33.

Medeiros, A.C., L.L. Loope, P. Conant, and S. McElvaney. 1997. Status, ecology, and management of the invasive plant, *Miconia calvescens* DC (Melastomataceae) in the Hawaiian Islands. *Records of the Hawaii Biological Survey for 1996*. Bishop Museum Occasional Papers 48:23-36.

Meyer, J.Y., and J. Florence. 1996. Tahiti's native flora endangered by the invasion of *Miconia calvescens* D.C. (Melastomataceae). *Journal of Biogeography* 23:775-781.

Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. Hawaii's comprehensive wildlife conservation strategy. Department of Land and Natural Resources, Honolulu, Hawaii. 722 pp.

Nagata, K. 1999. Zingiberaceae, ginger family. In Wagner, W.L., D.R. Herbst, and S.H. Sohmer (eds.), *Manual of the Flowering Plants of Hawaii*, University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Museum Special Publication 97. Pp. 1,616-1,624.

Palmer, D.D. 2003. Hawaii's ferns and fern allies. University of Hawaii Press, Honolulu. 324 pp.

Robichaux, R., J. Canfield, F. Warshauer, L. Perry, M. Brueggemann, and G. Carr. 1998. Radiating plants-adaptive radiation. *Endangered Species Bulletin* November/December. Pp. 3-5.

Smathers, G.A., and D.E. Gardner. 1978. Stand analysis of an invading firetree (*Myrica faya* Aiton) population, Hawaii. *Proceedings of the 2nd Conference on Natural Science, Hawaii Volcanoes National Park*. Pp. 274-288.

Smith, C.W. 1985. Impact of alien plants on Hawaii's native biota. In Stone, C.P., and J.M. Scott (eds.), *Hawaii's Terrestrial Ecosystems: Preservation and Management*, Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. Pp. 180-250.

Smith, C.W. 1989. Non-native plants. In *Conservation Biology in Hawaii*, Stone, C.P., and D.B. Stone (eds.), Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. Pp. 60-69.

Smith, C.W. 1998. Impact of alien plants on Hawaii's native biota. Cooperative National Park Studies Unit. http://www.botany.hawaii.edu/faculty/cw_smith/aliens.htm#Plant%20Pests%20of%20Hawaiian%20Native, accessed on February 20, 2007.

State of Hawaii. 2001. Game mammal hunting guide. http://hawaii.gov/dlnr/dofaw/hunting/game_summary, downloaded May 10, 2013.

The Nature Conservancy of Hawaii. 1999. Waikamoi Preserve, east Maui, Hawaii, long-range management plan, fiscal years 2001-2006. 29 pp. plus appendices.

The Nature Conservancy. 2008. Kapunakea Preserve, west Maui, Hawaii: long-range management plan fiscal years 2010-2015. 30 pp.

Tomich, P.Q. 1986. *Mammals in Hawaii; a synopsis and notational bibliography*. Bishop Museum Press, Honolulu. 375 pp.

(USFWS) U.S. Fish and Wildlife Service. 2005. West Maui mountains fencing and ungulate removal; Partners for Fish and Wildlife (122000G012).

Vitousek, P.M., C.M. DAntonio, L.L. Loope, M. Rejmanek, and R. Westerbrooks. 1997. Introduced species: a significant component of human-caused global change. *New Zealand Journal of Ecology* 21:1-16.

Wagner, W.L., D.R. Herbst, and R.S.N. Yee. 1985. Status of the native flowering plants of the Hawaiian Islands. In Stone, C.P., and J.M. Scott (eds.), *Hawaii's Terrestrial Ecosystems: Preservation and Management*, Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. Pp. 23-74.

Wagner, W.H. 1993. New species of Hawaiian pteridophytes. *Contributions from the University of Michigan Herbarium* 19:63-82.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999a. *Manual of the flowering plants of Hawaii*. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Museum Special Publications 97:1-1,918.

Wagner, W.L., M.M. Brueggmann, and J.Q.C. Lau. 1999b. Hawaiian vascular plants at risk: 1999. *Bishop Museum Occasional Papers* 60:1-58.

Wester, L. 1992. Origin and distribution of adventive alien flowering plants in Hawaii. In Stone, C.P., C.W. Smith, and J.T. Tunison (eds.), *Alien Plant Invasions in Native Ecosystems of Hawaii: Management and Research*, Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu. Pp. 99-154.

Personal Communications and In Litteris

Bily, P., The Nature Conservancy, Electronic mail response to request for candidate species information, dated February 13, 2009.

Ching, S., Plant Extinction Prevention Program, Oahu, Electronic mail message regarding status of candidate plants on Oahu, dated March 11, 2011.

Conry, P.J., DOFAW, 2012 CNOR, request for comments on USFWS species assessment and listing priority assignment forms, April 9, 2012.

Hadway, L. DOFAW, CNOR 2013 request for comments on USFWS species assessment and listing priority assignment forms, April 12, 2013.

Imoto, R. DOFAW, CNOR 2013 request for comments on USFWS species assessment and listing priority assignment forms, March 23, 2013.

Kawelo, K., U.S. Army Environmental, Electronic mail regarding current status of candidate plant species on Oahu, February 10, 2010.

Lau, J., Hawaii Biodiversity and Mapping Program, Telephone interview regarding status of *Microlepidia strigosa* var. *mauiensis*, March 14, 2007.

Oppenheimer, H. Plant Extinction Prevention Program, Electronic mail message regarding status of *Microlepidia strigosa* var. *mauiensis*, dated February 8, 2007.

Oppenheimer, H., Electronic mail message regarding status of *Microlepidia strigosa* var. *mauiensis* on Maui, dated February 18, 2008.

(PEPP) Plant Extinction Prevention Program. 2012. *Plant Extinction Prevention Program Annual Report, Fiscal Year 2012 (July 1, 2011-June 30, 2012)*, Hawaii Department of Land and Natural Resources-Division of Forestry and Wildlife. 169 pp.

Perlman, S., National Tropical Botanical Garden, Electronic mail message regarding status of candidate plants, dated March 21, 2011.

Welton, P., National Park Service, Electronic mail message regarding status of *Microlepidia strigosa* var. *mauiensis* on Maui, dated February 21, 2008.

Welton, P., Electronic mail message regarding status of candidate plants on Maui, dated March 15, 2010.

Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:



06/13/2013

Date

Concur:



10/28/2013

Date

Did not concur:

Date

Director's Remarks: